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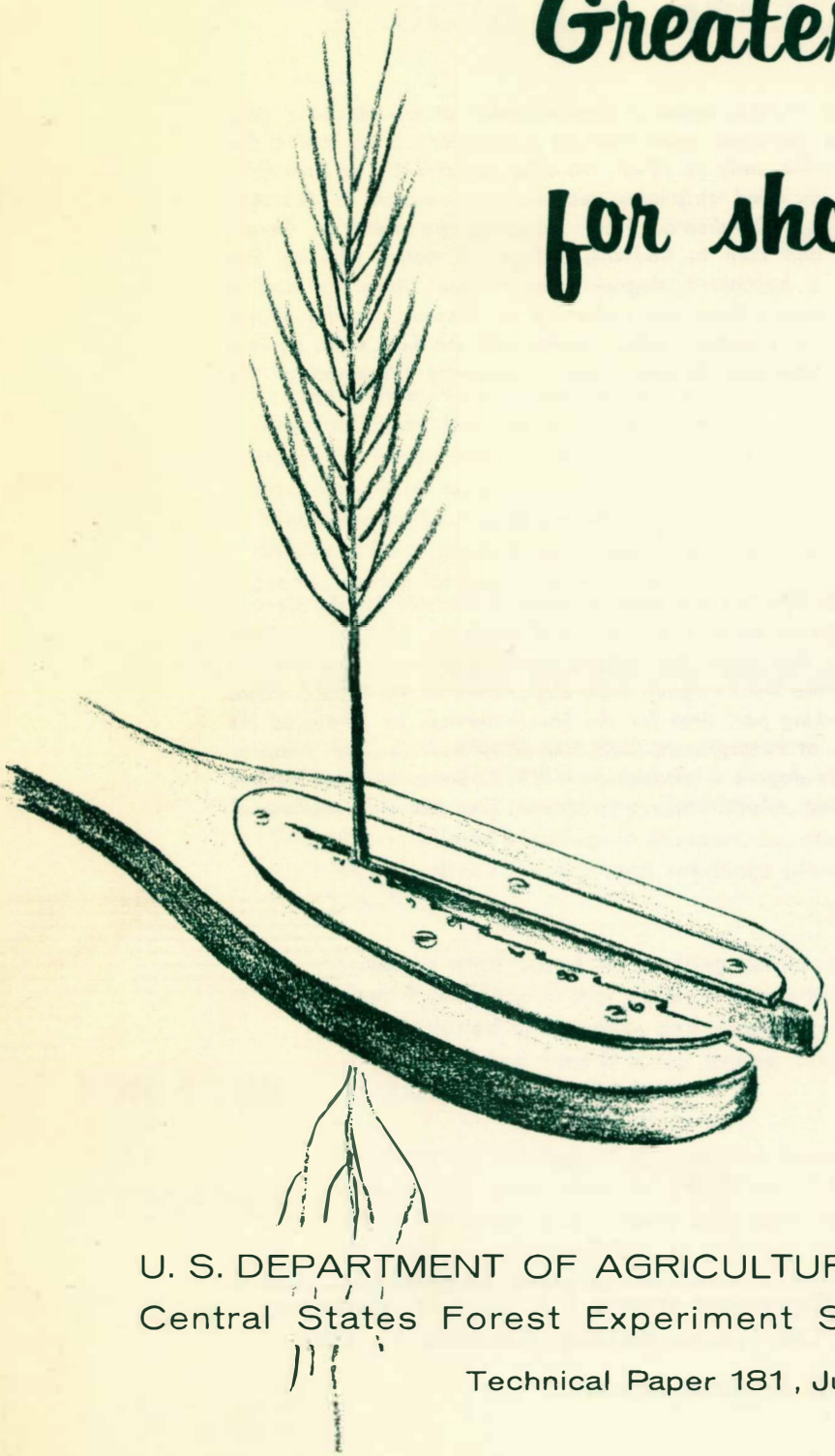

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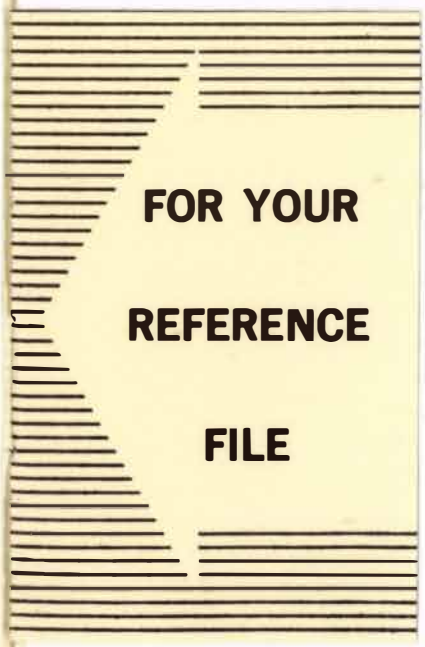
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FILE

Graded Stock means Greater Yields for shortleaf pine

F. Bryan Clark
Robert E. Phares

Twenty-year research results clearly show that, when planting shortleaf pine (*Pinus echinata* Mill.) on poor sites in the Central States, it pays to use sturdy stock. For better survival and higher timber yields, 1-0 shortleaf pine planting stock should be at least 6 inches tall with a stem caliper of 3/20 inch or more 1 inch above the root collar. This study demonstrates that greater yields can be obtained from graded stock and that the tree planter can likely afford a premium price for high-quality stock.

SEVERAL SIZES OF STOCK TESTED

Survival and growth comparisons of several sizes of 1-0 shortleaf pine seedlings began in 1939 on old-field sites within the national forests of southern Indiana and southern Missouri. The study was expanded in 1940 and 1941 with additional plantings in Missouri. Seedlings planted in Indiana were grown in an Indiana nursery, and seedlings planted in Missouri were grown in a Missouri nursery.

Stock classes were based on seedling height above the root collar and on stem caliper 1 inch above that point. Two seedling height classes were used but class limits varied by nurseries and years according to the stock available. Seedling height ranged from 3 to 12 inches. Stem caliper classes used were 2/20 inch, 3/20 inch, and 4/20 inch.

Combinations of two height classes and three caliper classes were used for a total of six stock sizes in 1939 and 1941. Each stock class was replicated in six subplots arranged in a Latin-square design. In 1940 the 4/20-inch class was not available, so only four size classes were tested with four subplots for each size class.

Each subplot contained either 16 or 25 trees of a single size. Seedlings were planted 4 feet by 4 feet in Indiana and 6 feet by 6 feet in Missouri. Seedlings with damaged roots, roots less than 8 inches long, and roots without laterals were culled. All roots were pruned to 8 inches before planting.

SURVIVAL AND YIELD VARIED

Twenty-year survival was best in plots planted with the biggest seedlings. Moreover the biggest seedlings had produced the greatest total cubic-foot volume and the most fence posts. On the other hand total tree height at 20 years was not correlated with planting stock size. Large seedlings grew faster in diameter at breast height in Indiana but not in Missouri.

Stock with the 4/20-inch stem caliper survived best 19 to 21 years after planting (table 1). Differences in survival by caliper classes were significant at the 1 percent level. For a given caliper class, tall seedlings had the best survival except for the 1941 Missouri plot. Early results of these same plantings were reported by Chapman[1] in 1948 and the relation found then between seedling size and survival was essentially unchanged in 1959. Mortality from 1944 to 1959 was negligible for all stock sizes.

Height growth, unlike survival, did not follow the early trend. Large seedlings grew tallest during the first 3 to 5 years. This same trend was found for 12-year-old red pine (*Pinus resinosa* Ait.) by Curtis[2] and 11-year ponderosa (*Pinus ponderosa* Laws.) and Jeffrey (*Pinus jeffreyi* Grev. & Balf.) pine by Fowells[3]. However, at 19 to 21 years total height differed only 1 to 2 feet among stock classes of a single planting but differed as much as 8 feet among sites. Although the largest stock was usually tallest, the difference had little practical significance. So the faster early height growth rate of large seedlings previously reported was not a strong growth trend.

Average d.b.h. of trees in 1959 ranged from 4.0 inches in Indiana to 6.4 inches in Missouri, chiefly because of differences in spacing. In Indiana trees from the largest stock averaged 4.6 inches in d.b.h. while trees from the smallest stock averaged 4.0 inches. Diameter differences among caliper and height classes were significant at the 1 percent level. But in Missouri there was no relation between seedling size and d.b.h. in 1959[4]. The reason for the different response between states is not known.

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[1]Chapman, A. G. Survival and growth of various grades of shortleaf pine planting stock. Iowa State Col. Jour. Sci. 22(4): 323-331. 1948.

[2]Curtis, Robert O. Use of graded nursery stock for red pine plantations. Jour. Forestry 53: 171-173, illus. 1955.

[3]Fowells, H. A. The effect of seed and stock sizes on survival and early growth of ponderosa and Jeffrey pine. Jour. Forestry 51: 504-507, illus. 1953.

[4]Diameter was adjusted for stand density by analysis of covariance but no relationship was found between adjusted tree diameter and stock size in Missouri.

Table 1.—Average survival, height, diameter, and cubic-foot volume in 1959 by seedling class

Year planted, location, and spacing	Seedling class: Height (inches)	Seedling class: Caliper (inches)	Survival	Average height	Average d.b.h.	Total volume[1] per acre
			Percent	*Feet*	*Inches*	*Cubic feet*
1939 — Indiana	3 — 6	2/20	74	35	4.0	3,194
4 by 4 feet	3 — 6	3/20	74	36	4.2	3,426
	3 — 6	4/20	90	36	4.4	4,600
	6 — 9	2/20	81	36	4.4	4,046
	6 — 9	3/20	88	37	4.3	4,328
	6 — 9	4/20	92	37	4.6	5,136
1939 — Missouri	4 — 8	2/20	49	31	6.1	2,440
6 by 6 feet	4 — 8	3/20	56	31	6.2	3,149
	4 — 8	4/20	70	32	6.3	3,965
	8 — 12	2/20	57	31	6.2	3,158
	8 — 12	3/20	69	32	6.4	4,044
	8 — 12	4/20	86	32	6.2	4,696
1940 — Missouri	4 — 7	2/20	69	29	5.5	1,906
6 by 6 feet	4 — 7	3/20	88	30	5.7	2,652
	7 — 10	2/20	80	31	5.8	2,595
	7 — 10	3/20	88	31	5.7	2,701
1941 — Missouri	4 — 8	2/20	60	29	5.8	2,725
6 by 6 feet	4 — 8	3/20	67	29	5.8	3,054
	4 — 8	4/20	86	29	5.7	3,715
	8 — 12	2/20	58	29	5.9	2,616
	8 — 12	3/20	59	30	5.8	2,741
	8 — 12	4/20	75	30	5.9	3,576

[1]Total cubic-foot volume, including stump and top, derived by regression formula previously published (Clark, F. Bryan and Williams, Robert D. Cubic foot volume tables for planted shortleaf pine. U.S. Dept. Agr., Forest Serv., Cent. States Forest Expt. Sta. Note 121, 2 pp. 1958).

The best way to judge planting success is by the quantity and quality of wood produced. Cubic-foot volume was consistently greater for the large stock classes in 1959, chiefly because more of the large trees survived. In the 1939 Missouri planting for example, subplots of the largest stock had 4,700 cubic feet of volume per acre while subplots of the smallest stock had only 2,440 cubic feet. Volume differences among caliper classes were statistically significant for all plots.

A tally of merchantable, 7-foot fence posts was made in the Missouri plots so that differences in yield among stock-size classes could be expressed in dollars. From the present value of posts per thousand trees planted (table 2) it

is obvious that a planter can afford to pay a premium for high-quality stock. Trees from the largest stock have better survival, but they also have better form with a corresponding greater post yield. Hence the planter's additional investment in stock may well be liquidated at the first commercial thinning.

Table 2.—Number and value of fence posts in 1959 per 1,000 trees planted by seedling class, Missouri plantings

Seedling class				
Year planted	Height (inches)	Caliper (inches)	Posts	Value of posts[1]
			Number	*Dollars*
1939	4 — 8	2/20	680	34.00
	4 — 8	3/20	890	44.50
	4 — 8	4/20	1,200	60.00
	8 — 12	2/20	980	49.00
	8 — 12	3/20	1,170	58.50
	8 — 12	4/20	1,520	76.00
1940	4 — 7	2/20	840	42.00
	4 — 7	3/20	1,280	64.00
	7 — 10	2/20	1,280	64.00
	7 — 10	3/20	1,260	63.00
1941	4 — 8	2/20	830	41.50
	4 — 8	3/20	920	46.00
	4 — 8	4/20	1,120	56.00
	8 — 12	2/20	870	43.50
	8 — 12	3/20	840	42.00
	8 — 12	4/20	1,160	58.00

[1]Stumpage value of 5 cents per 7-foot post.

WHAT SIZE TO PLANT

Results of this study provide the basis for shortleaf pine planting stock recommendations for the Central States. The best single criterion for grading shortleaf is stem caliper. Although seedling height alone is not always indicative of superior quality it is a good factor to couple with stem caliper.

For best results plant seedlings with at least a 3/20-inch caliper (1 inch above the root collar) and a 6-inch top. Seedlings 10 to 12 inches tall should have at least a 4/20-inch stem caliper. Seedlings less than 4 inches tall or 2/20 inch in caliper should be discarded.

At present, various grades of seedlings are not generally available. A common practice is to offer bedrun stock that has been culled for undersized, damaged, or diseased seedlings. This practice is satisfactory if a majority of the stock falls in the desirable size class. But if seedlings with stem caliper 2/20 inch and bigger are accepted then the tree planter risks receiving an order of seedlings that meets minimum standards but contains only a few desirable or premium seedlings.

There are two solutions to this problem: One is for the nurseryman to offer stock by grades and charge a premium price for high-quality stock; the other is to offer stock that contains no more than 25 percent minimum standard size. For contract planting a clause stating an acceptable percentage of minimum standard seedlings would be an excellent safeguard for the person letting the contract.

Clark, F. Bryan and Phares, Robert E.
1961. GRADED STOCK MEANS GREATER YIELDS FOR SHORTLEAF PINE. U.S. Dept. Agr., Forest Serv., Cent. States Forest Expt. Sta. Tech. Paper 181, 5 pp.

Studies of shortleaf pine (*Pinus echinata* Mill.) plantations in Missouri and Indiana show that use of sturdy planting stock (at least 6 inches in stem length and 3/20-inch caliper) pays off in better survival and greater timber yields.

The Central States Forest Experiment Station is headquartered at Columbus, Ohio and maintains major field offices at:

Ames, Iowa (in cooperation with Iowa State University)
Athens, Ohio (in cooperation with Ohio University)
Bedford, Indiana
Berea, Kentucky (in cooperation with Berea College)
Carbondale, Illinois (in cooperation with Southern Illinois University)
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